SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

METHOD 5.2

DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES USING HEATED PROBE AND FILTER

TECHNICAL SUPPORT SERVICES
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METHOD 5.2

DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES USING HEATED PROBE AND FILTER

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1. Overview

1.1 Principle

A sample is withdrawn isokinetically from the source through a sample train by a metering system. Filterable particulate matter is collected on a heated glass fiber filter. Condensables and particulate passing through the filter are collected in impingers containing deionized water. The impingers are contained in an ice bath to maintain a sampled gas temperature of approximately 15°C (60°F). A separate train for sulfuric acid mist may be required (see Section 1.2).

The total particulate mass, measured gravimetrically, is defined as the sum of the mass collected from the probe, filter, washings, and impingers after removal of uncombined water,

the organic extraction, and the sulfuric acid mist collected in a separate SO_x train (if required). The solid particulate matter is defined as total particulate matter minus extractable organic matter and sulfuric acid.

An adjustment to the impinger catch is allowed for sulfuric acid formed from reactions between SO_2 and SO_3 with the sample train components. When ammonia is injected to enhance the efficiency of a control device, a second adjustment to the impinger catch is allowed for total sulfate. This adjustment is allowed for fluid catalytic cracking units only.

Because of the complexity of this method testers must be trained and experienced in the test procedures.

1.2 Probe and Filter Temperature

Particulate matter passing through the probe and filter is caught in the impingers. Some of the particulate passing through the heated probe and filter may be either sublimed or submicron solid particulate matter, and therefore the particulate caught in the probe and filter does not meet the definition of solid particulate matter.

If the probe and filter are kept above 93°C (200°F) and sulfuric acid is present in the sampled gas in quantities greater than 10 percent of the standard for applicable rule, a separate and concurrent measurement of sulfuric acid is required, using the process described in Method 6.1. If the process is steady state and sulfuric acid is less than 10 percent of the standard for the applicable rule, concurrent sampling is not required.

If the temperature of the probe and filter is maintained at 82-93°C (180-200°F), all the liquid sulfuric acid present in the sampled gas will be caught by the probe and filter.

1.3 Applicability

This method is used to measure particulate emissions from stationary sources. If the probe and filter temperature is maintained at 120 ± 14°C (248 ± 25°F) this method can be followed for NSPS tests. Only the particulate matter collected in the probe and filter is used

for NSPS compliance. For District Rules, the particulate matter collected on both halves of the train is used.

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2. Field Procedures

2.1 Sampling Apparatus

2.1.1 Sampling Train

A schematic of the sampling train used in this method is shown in Figure 5.2-1. The procedure for the preparation of the sample collection train (consisting of probe liner, impinger train, and filter holder with filter) is given in Section 3.2.1.

Figure 5.2-1 shows the impinger train affixed to the heated filter box. The impingers can be separate and connected to the filter with inert tubing that will withstand the filter outlet temperature.

The sampling train consists of the following components:

a. Probe Nozzle

The nozzle material should be 316 stainless steel or glass, with sharp, tapered leading edge. The taper angle should be $\leq 30^{\circ}$ and on the outside, to preserve a constant internal diameter. The stainless steel nozzle should be constructed from seamless tubing. Other materials which will not be corroded by the sampled gases or interfere with sample recovery may be used.

A range of nozzle sizes suitable for isokinetic sampling should be available in increments of 0.16 cm (1/16 in.), e.g. 0.32 to 1.27 cm (1/8 to 1/2 in.) or larger if higher volume sampling trains are used.

Each nozzle must be calibrated according to the procedure outlined in Method 5.1, Section 2.1.

b. Probe Liner

Use borosilicate or quartz glass tubing with a heating system capable of maintaining a gas temperature above the dew point at the exit end during sampling as described in Section 1.2.

Either borosilicate or quartz glass probe liners may be used for stack temperatures up to about 480°C (900°F); use quartz liners for temperatures between 480°C and 900°C (900°F and 1650°F). If high temperatures are encountered see Chapter X section on Sampling High Temperature Sources.

Whenever practical, use borosilicate or quartz glass probe liners. Otherwise use metal liners made of seamless tubing (e.g. 316 stainless steel, Inconel, Incoloy 825, or other corrosion resistant metals) when acid particulates are present in concentrations less than 1 mg/m^3 at

probe conditions or SO_2 is less than 20 ppm.

When assembling the probe and nozzle, verify that all components, including ferrules and other connectors, are heat-resistant, leak-free, and non-contaminating for the sample.

c. Pitot Tube

Use an S-type Pitot tube, as described in Section 1.1 of Method 2.1, or other device approved by the Executive Officer. Attach the Pitot tube to the probe, as shown in Figure 5.2-1, to allow constant monitoring of the stack gas velocity. If this is not practical see Chapter X section on Flue Factor.

The impact (high pressure) opening plane of the Pitot tube must be even with or above the nozzle entry plane (see Method 2.1) during sampling. The S-type Pitot tube assembly must have a

known coefficient, as determined in Method 2.1.

d. Differential Pressure Gauge

Use inclined manometer or equivalent device, as described in Method 2.1, for stack velocity head readings, and a separate manometer for orifice differential pressure readings.

e. Filter Holder

Use a borosilicate glass filter holder, with a Teflon, Teflon-coated stainless steel, or stainless steel support and a silicone rubber gasket. Other materials such as stainless steel, Teflon, or Viton may be used if they do not react with the particulate matter or sampled gases. Fritted-glass filter supports are unsatisfactory for post-filter analysis. The filter holder design provides a positive seal against leakage from the outside or around the filter. Attach the holder immediately

at the outlet of the probe, or cyclone, if used.

f. Filter Heating System

Use any heating system capable of maintaining the temperature around the filter holder during sampling above the dewpoint of the sampled gases. Install a temperature gauge capable of measuring temperature to within 3°C (5.4°F) so that the temperature around the filter holder can be monitored and regulated during sampling.

g. Impinger Train

The train consists of four Greenburg-Smith design impingers connected in series with leak-free ground glass fittings, or any similar leak-free non-contaminating fittings. The first and second impingers must be of the Greenburg-Smith design with the standard tip. The third and fourth impingers must be of the Greenburg-Smith design, modified by replacing

the tip with 1.3 cm (1/2 in.) ID glass tube extending to about 1.3 cm (1/2 in.) from the bottom of the flask.

Acceptable modifications include the following: using flexible connections between the impingers, using materials other than glass, or using flexible vacuum lines to connect the filter holder to the impinger train.

The first and second impingers contain 100 ml of water, the third is empty, and the fourth contains a known weight of silica gel, or equivalent desiccant. Place a thermometer capable of measuring temperature to within 1°C (2°F) at the outlet of the fourth impinger to monitor outlet gas temperature.

Instead of using silica gel the moisture leaving the third impinger may be measured by monitoring the temperature and pressure at the exit of the impinger train and using Dalton's law of partial pressures.

Even if means other than silica gel are used to determine the amount of moisture leaving the impinger train, silica gel, or equivalent, should be used between the impinger system and pump to prevent moisture condensation in the pump and metering devices.

h. Metering System

The metering system includes vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3°C (5.4°F), dry gas meter capable of measuring volume to within 2 percent, and related equipment, as shown in Figure 5.2-1. An alternative to the thermometers and dry gas meters is an equivalent temperature-compensated dry gas meter. When the metering system is used in conjunction with a Pitot tube, the system should allow for checks of isokinetic rates.

2.1.2 Barometer

A mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm (0.1 in.) Hg may be used. Alternatively, the barometric reading may be obtained from a nearby National Weather Service (NWS) station. Request the station value (which is the absolute barometric pressure) and adjust for elevation difference between the NWS station and the sampling point at the rate of minus 2.5 mm (0.1 in.) Hg per 30 m (100 ft) elevation increase or plus the same adjustment for elevation decrease.

2.1.3 Temperature Determination Equipment

Use the temperature sensor described in Method 2.1. Preferably the temperature sensor should be permanently attached to the Pitot tube or sampling probe so that the tip of the sensor extends beyond the leading edge of the probe sheath and touches no metal. Alternatively, the sensor may be attached just prior to use

in the field. If the temperature sensor is attached in the field, place it in an interference-free arrangement with respect to the S-type Pitot tube openings (see Method 2.1).

As another alternative, if a difference of not more than 1 percent in the average velocity measurement and resulting stack flow rate calculation would be introduced, the temperature gauge need not be attached to the probe or Pitot tube.

2.1.4 Sulfuric Acid Determination Equipment

Same as Method 6.1.

If the process is steady state and sulfuric acid is less than 10 percent of the standard for the applicable rule, concurrent sampling is not required.

2.1.5 Gas Molecular Weight Determination Equipment

Same as Method 3.1. If the process is steady state and the molecular weight

varies less than 2 percent, concurrent sampling is not required.

2.2 Sampling Reagents

a. Filters

Glass fiber filters, without organic binder.

The filters should be at least 99.95 percent efficient ($\leq$ 0.05 percent penetration) on 0.3 micron dioctylphthalate smoke particles. Conduct the filter efficiency test in accordance with ASTM Standard Method D-2986-71, or use test data from the supplier's quality control program. Low sodium filters are recommended when SO_2 is present.

b. Silica Gel

Indicating-type, 6 to 16 mesh.

Use new silica gel as received. If previously used, dry at 175°C (350°F) for 2 hours. Other desiccants may be used, subject to the approval of the Executive Officer.

c. Water

Deionized, distilled water to conform to ASTM specification D-1193-77 Type 3.

At the option of the chemist, the $KMnO_4$ test for oxidizable matter may be eliminated when high concentrations of organic matter are not expected to be present. Reference to water throughout this method implies deionized, distilled water.

Run blanks prior to field use to eliminate a high blank on test samples.

d. Crushed Ice or Dry Ice Pellets

e. Stopcock Grease

Stopcock grease is not recommended and not necessary if screw-on connectors with Teflon sleeves, or similar, are used. Acetone-insoluble, heat-stable silicone grease may be used. Other types of grease may be used subject to the approval of the Executive Officer.

2.3 Pretest Determinations

Select the sampling site and the minimum number of sampling points according to Method 1.1. If it is not possible to follow Method 1.1, or more than one sample site must be tested, see Chapter X. Determine the stack pressure, temperature and the range of velocity heads using Method 2.1.

Determine the moisture content, using Method 4.1 or its alternative, to make isokinetic sampling rate settings.

Determine the stack gas dry molecular weight as described in Method 3.1. If integrated sampling (Method 3.1) is used for molecular weight determination, take the integrated bag sample throughout the total time of the particulate sample run, unless the effect on the velocity measurement and resulting stack flow rate calculation is less than 1 percent. In that case take the integrated sample immediately before, after, or for a shorter time during the particulate sample run.

Select a nozzle size based on the range of velocity heads encountered, so that it is not necessary to change the nozzle size to maintain isokinetic sampling rates. Do not change the nozzle size during the run. Choose the differential pressure gauge appropriate for the range of velocity heads encountered (see Method 2.1).

Select a probe length suitable for sampling all traverse points. Consider sampling large stacks from opposite sides (four sampling port holes) to reduce the probe length.

Select a total sampling time equal to or greater than the minimum total sampling time specified in procedures for the specific industry. The sampling time per point must not be less than 2 minutes and the sample volume taken (corrected to standard conditions) shall not be less than 30 ft^3.

To avoid timekeeping errors, the number of minutes sampled at each point should be an integer or an integer plus one-half minute. The sampling time should be the same at each point. In some circumstances, e.g. batch cycles, it may

be necessary to sample for shorter times at the traverse points, resulting in smaller gas sample volumes. In these cases, test two or more cycles.

2.4 Gas Volume Meter Checks

Check the meter against the ▲H@ orifice calibration obtained in Chapter III without the probe, filter, and train connected. A pretest check is recommended. A post test check is mandatory.

Check the calibration of the metering system by performing calibration runs at three different flow rates. Set the flow rate at 0.4 cfm ± 10 percent, 0.75 cfm ± 10 percent and 1.0 cfm ± 10 percent. The calibration will be used to calculate ▲H@ at these three flow rates, where ▲H@ is calculated as follows:

$$\blacktriangle H@ = 0.0319 \blacktriangle H \frac{T_m \Theta^2}{P_{bar} (Y^2 V_m^2 A^2)}$$

where:

$\Delta H@$ = Average pressure differential across the orifice meter, in. H_2O at 0.75 scfm (528°F, 29.92 in. Hg)

T_m = Absolute average dry gas meter temperature, °R

P_{bar} = Barometric pressure, in. Hg

θ = Total sampling time, min

Y = Dry gas meter calibration factor, dimensionless, obtained from Chapter III

ΔH = Pressure differential across the orifice, in. H_2O

V_m = Volume of gas sample as measured by dry gas meter, dcf

0.0319 = (0.0567 in. Hg/°R) x $(0.75 \text{ cfm})^2$

A = 1, if meter is not temperature compensated

$$= \frac{T_m}{\text{Compensated Temp. } (^{o}R)}$$

if temperature compensated

If the measured ▲H@ differs by more than ± 3 percent of the actual ▲H@ obtained in Chapter III, the results of the tests are voided.

Alternative procedure (e.g. using an orifice meter with a known K-Factor) may be used, subject to the approval of the Executive Officer.

2.5 Pretest Preparation

Set up the train as in Figure 5.2-1.

Mark the probe with heat-resistant tape or by some other method to denote the proper distance to insert the probe into the stack or duct for each sampling point.

Place crushed ice or dry ice pellets around the impingers.

2.6 Leak Checks

2.6.1 Pretest Leak Check

After the sampling train has been assembled, turn on and set the filter and probe heating systems at the desired operating temperatures. Allow time for the temperatures to stabilize. If a Viton A O-ring or other leak-free connection is used in assembling the probe nozzle to the probe liner, leak check the train at the sampling site by plugging the nozzle and drawing a 380 mm (15 in.) Hg vacuum.

A lesser vacuum may be used if it is not exceeded during the test. The probe may be leak checked at a pressure equal to the stack pressure minus 25 mm (1 in.) Hg. Alternatively, the probe may be leak checked with the rest of the sampling train, at 380 mm (15 in.) Hg vacuum.

A leakage rate in excess of either 4 percent of the average sampling rate or 0.00057 m^3/min (0.02 cfm) is unacceptable.

Start the pump with the bypass valve fully open and the coarse adjust valve completely closed. Partially open the coarse adjust valve and slowly close the bypass valve until the desired vacuum is reached. Do not reverse direction of bypass valve; this will cause water to back up into the filter holder. If the desired vacuum is exceeded, either leak check at this higher vacuum or end the leak check as shown below and start over.

When the leak check is completed, slowly remove the plug from the inlet to the probe, and then turn off the vacuum pump. This prevents the water in the impingers from being forced backward and silica gel from being entrained.

Perform a leak check of the Pitot lines. (See Method 2.1).

2.6.2 Leak Check During Sampling Run

If a component change (e.g. filter assembly or impinger) becomes necessary

during the sampling run, conduct a leak check immediately before the change is made. Use the pretest leak check procedure, but use a vacuum equal to or greater than the maximum value recorded up to that point in the test.

If the leakage rate is no greater than either 0.00057 m^3/min (0.02 cfm) or 4 percent of the average sampling rate, the results are acceptable and no correction has to be applied to the total volume of dry gas metered. However, if the leakage rate exceeds either of these limits, the tester must either record the leakage rate and correct the sample volume as shown in Chapter X or void the sampling run. Immediately after component changes, perform pretest leak check.

2.6.3 Post Test Leak Check

A leak check is mandatory at the conclusion of each sampling run. Follow the procedures outlined in Section 2.6.1 at a vacuum equal to or greater than the maximum value reached during the sampling

run. Compare the leakage rate to the limits indicated in Section 2.6.2 and follow the procedure described there.

2.7 Sampling Train Operation

During the sampling run, maintain an isokinetic sampling rate within 10 percent of true isokinetic and a temperature around the filter at 180°-200°F or $248^{\circ} \pm 25^{\circ}$F, as required. Be sure to record the initial dry gas meter reading. Record the dry gas meter readings at the beginning and end of each sampling time increment, when changes in flow rates are made, before and after each leak check, and when sampling is halted.

Record other date required by the sheet in Figure 5.2-2 at least once for each sample point during each time increment. Take additional readings when significant changes (20 percent variation in velocity head readings) require adjustments in flow rate.

Level and zero the manometer and make periodic checks during the traverse, because the manometer

level and zero may drift due to vibrations and temperature changes.

Clean the portholes prior to the test run to minimize the chance of contamination. To begin sampling, verify that the filter and probe heating systems are up to temperature, remove the nozzle cap, and verify that the Pitot tube and probe are properly positioned.

During the period before sampling the nozzle can be pointed downstream. Position the nozzle at the first traverse point and rotate the nozzle until the tip is pointing directly into the gas stream before turning on the sampling pump. Immediately start the pump and adjust the flow to isokinetic conditions.

Use calculators or nomographs to expedite adjustment of the isokinetic sampling rate.

When the stack is under significant negative pressure (height of water in impinger stem), take care to close the coarse adjust valve before inserting the probe into the stack to prevent water from backing into the filter holder. If

necessary, the pump may be turned on with the coarse adjust valve closed.

When the probe is in position, block off the openings around the probe and porthole to prevent unrepresentative disturbances and dilution of the gas stream.

If needed, start the $H_2SO_4 \cdot 2H_2O$ sample train following procedures outlined in Method 6.1. Traverse the stack cross section, as required by Method 1.1. Be careful to avoid bumping the probe nozzle into the stack walls when sampling near the walls or when removing or inserting the probe through the portholes. This minimizes the chance of extracting stack deposits.

During the test run, make periodic adjustments to keep the temperature around the filter holder at the proper level; add more ice to maintain a temperature less than 15°C (60°F) at the condenser/silica gel outlet. Also, periodically check the level and zero of the manometer. Note and investigate any changes in stack temperature or velocity pressure over those measured during previous tests or traverses. Changes can mean

failure of sampling equipment or a change in the process.

If the pressure drop of the filter becomes too high, making isokinetic sampling difficult to maintain, the filter may be replaced during a sample run. Use another complete filter assembly rather than attempting to change the filter itself. Before a new filter assembly is installed, conduct a leak check (see Section 2.6.2).

The total particulate weight includes the summation of all filter assembly catches. Use a single train for the entire sample run, except when sampling is required in two or more ducts or at two or more locations within the same duct, or when equipment failure necessitates a change of trains. When two or more trains are used, separate analyses of the front-half and impinger catches from each train must be performed.

At the end of the sample run, turn off the coarse adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final dry gas meter reading, and conduct a post test leak check, as outlined in Section 2.6.3. Also

leak check Pitot lines as described in Method 2.1. The lines must pass this leak check to validate the velocity head data. Perform a gas volume meter check as described in Section 2.4.

2.8 Calculation of Percent Isokinetic

Calculate percent isokinetic using the equation shown in Figure 5.2-4 to determine whether the run was valid or another test run should be made.

2.9 Sample Handling

Proper clean-up procedure begins as soon as the probe is removed from the stack at the end of the sampling period.

Allow the probe to cool. When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over it to prevent losing or gaining particulate matter. Do not cap off the probe tip tightly while the sampling train is cooling down. This would create a vacuum in the filter holder, drawing water from the impingers into the filter.

Before moving the sample train to the clean-up site, remove the probe from the sample train,

wipe off any stopcock grease, and cap the open outlets of the probe. Be careful not to lose any condensate that might be present. Wipe any stopcock grease off of the filter inlet where the probe was fastened and cap it. Remove the umbilical cord from the last impinger and cap the impinger. If a flexible line is used between the first impinger and the filter holder, disconnect the line at the filter holder and let any condensed water or liquid drain into the impingers or condenser. After wiping off any stopcock grease, cap off the filter holder outlet and impinger inlet. Either ground glass stoppers, plastic caps, or serum caps may be used to close these openings.

Transfer the probe, filter, and impinger assembly to the clean-up area. This area should be clean and protected from the wind to reduce chances of contaminating or losing the sample. It is recommended that sample recovery be performed in a controlled laboratory environment.

2.10 Calibrations

See Chapter III.

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DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES USING HEATED PROBE AND FILTER

Section 3 of 4

3. Laboratory Procedures

3.1 Apparatus

3.1.1 Sampling Train

See Section 2.1.

3.1.2 Sample Recovery

See Method 5.1, Section 3.1.2.

3.1.3 Analysis of Particulate Matter

See Method 5.1, Section 3.1.3.

3.1.4 Acid and Sulfate Analysis

See Method 5.1, Section 3.1.4.

3.2 Reagents

See Method 5.1, Section 3.2.

3.3 Pretest Preparation

See Method 5.1, Section 3.3.

3.4 Preparation of Sample Collection Train

Assemble the train as shown in Figure 5.2-1. Follow the loading and connection procedures found in Method 5.1, Section 3.4.

3.5 Leak Check

The sample collection train may be leak checked in the laboratory after assembly following the procedures found in Section 2.5.

3.6 Sample Recovery

Recover the sample in three fractions: filter, prefilter, and post-filter.

3.6.1 Filter

Recover the filter as described in Method 5.1, Section 3.6.1.

3.6.2 Prefilter

Recover the nozzle, probe, front half of the filter holder, and connecting glassware (if any) as the pre-filter fraction. Follow the procedure for probe and nozzle recovery in Method 5.1, Section 3.6.2.

3.6.3 Post-Filter

The post-filter fraction consists of the back half of the filter holder, the first three impinger catches, and connecting glassware. Measure the moisture gain using Method 4.1, and recover this fraction using the procedure in Method 5.1, Section 3.6.3.

3.7 Sample Analysis

The three fractions are analyzed separately using Method 5.1, Section 3.7 procedures. Apply the following procedures to the fractions as indicated:

3.7.1 Prefilter

Analyze the pre-filter fraction for total residue weight, acid content, and sulfate content. Organic extraction is not performed on this fraction because organic compounds do not normally deposit on heated train components.

3.7.2 Filter

Weigh the filter to constant weight and also analyze for acid content and sulfate content if collected sample is greater than 10 mg.

3.7.3 Post-Filter

Analyze the post-filter catch for organic residue (if requested), aqueous residue, acid content, and sulfate content.

NOTE: This fraction represents "condensable" particulates, i.e. compounds which condense at ambient conditions, and particles <0.3 microns in diameter. Filtration for insolubles is not required if performing organic extraction since the pre-filter catches most insoluble particulates.

3.8 Calculations and Reporting

Calculations are carried out as in Method 5.1. Results are reported as follows:

Total Impinger Volume, ml (g)
Impinger Gain, ml (g)
Silica Gel Gain, (g)
Pre-Filter Recovered Volume, ml (g)

Residue, mg

Acid, as $H_2SO_4.2H_2O$, mg

Sulfate, as $H_2SO_4.2H_2O$, mg

Filter Catch, mg

Acid, as $H_2SO_4.2H_2O$, mg

Sulfate, as $H_2SO_4.2H_2O$, mg

Post-Filter Recovered Volume, ml (g)

Organic Residue, mg

Aqueous (or Total) Residue, mg

Acid, as $H_2SO_4.2H_2O$, mg

Sulfate, as $H_2SO_4.2H_2O$, mg

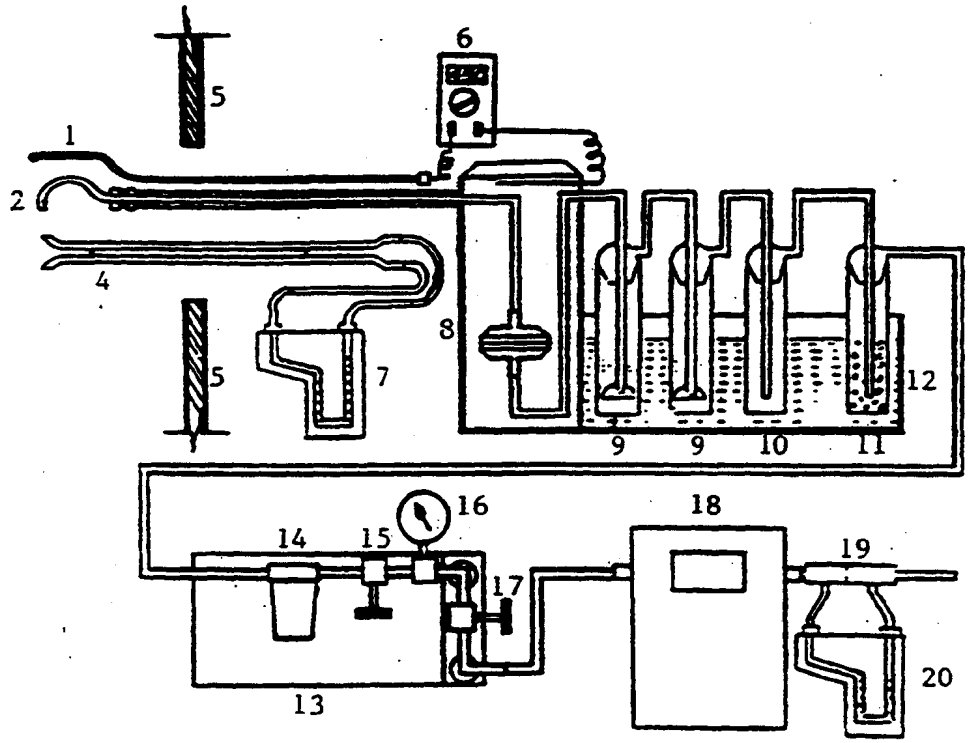
3.9 Calibrations

See Method 5.1, Section 3.9.

4. Engineering Calculations and Reporting

4.1 Calculations

Carry out calculations, retaining at least one decimal figure more than that of the acquired data. Round off figures after the final calculation. Other forms of the equations may be used as long as they give equivalent results. See Figures 5.2-3 and 5.2-4.



1. Temperature Sensor
2. Nozzle
3. Glass lined Stainless Steel Probe-Heated
4. S-type Pitot Tube
5. Stack Wall
6. Temperature Sensor Meter
7. Pitot Tube Inclined Manometer
8. Heated Box with Filter
9. Impinger with 100 ml H_2O
10. Empty Bubbler
11. Bubbler with Silica Gel
12. Ice Bath
13. Sealed Pump (Leak Free)
14. Filter for Pump
15. Metering Valve
16. Vacuum Gauge
17. By-pass Valve
18. Temperature Compensated Dry Gas Meter
19. Orifice
20. Orifice Inclined Manometer

Figure 5.2-1

Particulate Sampling Train Set-up with Heated Probe and Heated Filter

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Test No. ____________ Date: ____________

Sampling Location: ______________________________ Sample Train ______________________

TRAVERSE SOURCE TEST DATA

Pre-Test Leak Check:	Post-Test Leak Check:
Filter ______ cfm @ ______ "Hg vac	Filter ______ cfm @ ______ "Hg vac
Probe ______ cfm @ ______ "Hg vac	Probe ______ cfm @ ______ "Hg vac
(Pitot Tube Leak Check ________)	(Pitot Tube Leak Check ________)

Time		Sample Point	Gas Meter Reading	Stack		Calculated			Probe Temp.	Filter Temp.	Meter Temp °F		Vacuum
On	Off	#	(dcf)	Velocity Head ("H₂O)	Temp. °F	Velocity (fps)	Sampling Rate (cfm)	Orifice ΔP ("H₂O)	°F	°F	In	Out	"Hg
(Net Vol. Uncorr.)				Avg.									

Nozzle #

Nozzle Diameter ____________ mm (________ ")

Barometric Pressure ______________ "HgA

Recorded By ______________________

Pitot Factor .... ____________

Static Pressure in Stack .... ______________ "HgA (+/- ____________ "H₂O)

Calibration Data

Inclined Manometer ____________	(Cal: N/A)
Magnehelic No. ____________	(Cal: ____________)
Pitot Tube No. ____________	(Cal: ____________)
Potentiometer No. ____________	(Cal: ____________)
Thermocouple No. ____________	(Cal: ____________)
Gas Meter No. ____________	(Cal: ____________)
Meter Corr. Factor:	

Type Sampling Probe ______________________

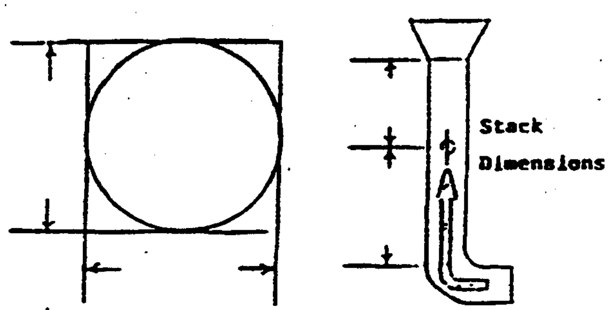


Figure 5.2-2

Traverse Source Test Data Sheet

PAGES	PAGE
TEST NO.	DATE
PROCESSED BY	CHECKED BY

CALCULATION SHEET

LAB ANALYSIS

A. Filter Catch ..... _____ mg
B. (1) Filter Acid ..... _____ mg
(2) Filter Total Sulfate ..... _____ mg
C. Probe Catch ..... _____ mg
D. (1) Probe Acid ..... _____ mg
(2) Probe Total Sulfate ..... _____ mg
E. Impinger Catch ..... _____ mg
F. (1) Impinger Acid ..... _____ mg
(2) Impinger Total Sulfate ..... _____ mg
G. Organic Extract ..... _____ mg
H. $H_2SO_4 \cdot 2H_2O$ from SO_x Train Thimble ..... _____ mg
I. Particulate Train Corrected Gas Volume Metered ..... _____ dscf
J. SO_x Train Corrected Gas Volume Metered ..... _____ dscf
K. Prorated $H_2SO_4 \cdot 2H_2O$ Mass $(\frac{H \times I}{J})$ ..... _____ mg

FILTER (PARTICULATE) TEMPERATURE GREATER THAN 200°F

L. Total Particulate (A-B*+C-D*+E-F*+G+K) ..... _____ mg
M. Solid Particulate (L-G-K) ..... _____ mg
N. Total Particulate (Corrected for Ammonium Sulfate)
(A-B*+C-D*+E-F(1)+G+K-[F(2)-(1)].$\frac{132}{134}$) ..... _____ mg
O. Solid Particulate (Corrected for Ammonium Sulfate)
(N-G-J) ..... _____ mg

FILTER TEMPERATURE LESS THAN 200°F

P. Total Particulate (A+C+E-F*+G) ..... _____ mg
Q. Solid Particulate (P-B*-D*-G) ..... _____ mg
R. Total Particulate (Corrected for Ammonium Sulfate)
(A+C+E-F(1)+G-[F(2)-F(1)].$\frac{132}{134}$) ..... _____ mg
S. Solid Particulate (Corrected for Ammonium Sulfate)
(R-B*-D*-G) ..... _____ mg

* USE LOWER OF (1) AND (2)

Figure 5.2-3
Calculation Sheet

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Test No. _____ Sampling Train _____ Date _____

Calculated By _____ Checked By _____

SOURCE TEST CALCULATIONS

SUMMARY

A. Average Traverse Velocity (Pre-Test) ..... _____fps
B. Average Reference Point Velocity (Pre-Test) ..... _____fps
C. Average Traverse Velocity (During Test) ..... _____fps
D. Gas Meter Temperature (Use 60°F, for Temp. Comp. Meters) ..... _____°F
E. Gas Meter Correction Factor ..... _____

F. Average Stack Temp. ... _____°F
G. Stack Cross-Sect. Area _____ft^2
H. Barometric Pressure ... _____"HgA
I. Gas Meter Pressure .... _____"HgA
J. Total Stack Pressure .. _____"HgA
K. Pitot Correction Factor _____
L. Sampling Time ..... _____min
M. Nozzle Cross-Sect. Area _____ft^2
N. Net Sample Collection . _____mg
O. Net Solid Collection .. _____mg
P. Water Vapor Condensed . _____ml
Q. Gas Volume Metered .... _____dcf

R. Corrected Gas Volume Metered $\left[(Q \times I/29.92) \times \frac{520}{(460 + D)} \times E\right]$. _____dscf

PERCENT MOISTURE / GAS DENSITY

S. Percent Water Vapor in Gas Sample $\left[\frac{4.64 \times P}{(0.0464 \times P) + R}\right]$ ..... _____%

T. Average Molecular Weight (Wet):

(Component)	(Volume % / 100)	× (1 − S/100)	× (Molec. Wt.)	= (Wt./Mole)
Water		1.00	18.0	
Carbon Dioxide	Dry Basis		44.0	
Carbon Monoxide	Dry Basis		28.0	
Oxygen	Dry Basis		32.0	
Nitrogen/Inerts	Dry Basis		28.2	
			(Sum)	

FLOW RATE

U. Gas Density Correction Factor ($\sqrt{28.95/T}$) ..... _____
V. Flue Correction Factor (A/B) ..... _____
W. Velocity Pressure Correction Factor ($\sqrt{29.92/J}$) ... _____
X. Corrected Velocity (C × K × U × V × W) ..... _____fps
Y. Flow Rate (X × G × 60) ..... _____cfm
Z. Flow Rate $\left[Y \times \frac{J}{29.92} \times \frac{520}{(460 + F)}\right]$ ..... _____scfm
AA. Flow Rate $\left[Z \times (1 - S/100)\right]$ ..... _____dscfm

SAMPLE CONCENTRATION/EMISSION RATE

BB. Sample Concentration (0.01543 × N/R) ..... _____gr/dscf
CC. Sample Concentration (54,143 × BB/____Molec. Wt.) ... _____ppm (dry)
DD. Sample Emission Rate (0.00857 × AA × BB) ..... _____lb/hr
EE. Solid Emission Rate $\left(\frac{0.0001322 \times O. \times AA}{R}\right)$ ..... _____lb/hr
FF. Isokinetic Sampling Rate $\left(\frac{G \times R \times V \times 100}{L \times M \times AA}\right)$ ..... _____%

Figure 5.2-4

Source Test Calculation Sheet